

CLAIMS

1. An apparatus for forming a two-dimensional image by light modulation, comprising:

a coherent light source;

a diffuser for diffusing light;

an illumination optical system for irradiating the diffuser with light emitted from the coherent light source;

a diffuser vibration unit for vibrating the diffuser; and

a spatial light modulator disposed near the diffuser, said modulator modulating the light that is emitted from the coherent light source and diffused by the diffuser;

wherein said diffuser vibration unit vibrates the diffuser at a velocity that satisfies an expression,

$$V > d \times 30 \text{ (millimeters/sec)}$$

which is established between the grain size d of the diffuser and the velocity V for vibrating the diffuser.

2. An apparatus for forming a two-dimensional image by light modulation, comprising:

a coherent light source;

a diffuser for diffusing light;

an illumination optical system for irradiating the diffuser with light emitted from the coherent light source;

a spatial light modulator disposed near the diffuser, said

modulator modulating the light that is emitted from the coherent light source and diffused by the diffuser; and

a projector lens for projecting an image which is obtained by light modulation by the spatial light modulator, on a certain plane in space;

wherein a diffusion angle of the diffuser is determined on the basis of a substantial numerical aperture of the illumination optical system, and a brightness of the projector lens.

3. A two-dimensional image formation apparatus as defined in Claim 2 wherein

a relationship,

$$\theta / 2 + \sin^{-1}(NA_{in}) < 2 \times \tan^{-1}(1/2f)$$

is established among the diffusion angle θ of the diffuser, the substantial numerical aperture NA_{in} of the illumination optical system, and the brightness f of the projector lens.

4. An apparatus for forming a two-dimensional image by light modulation, comprising:

a coherent light source;

a diffuser for diffusing light;

an illumination optical system for irradiating the diffuser with light emitted from the coherent light source;

a spatial light modulator disposed near the diffuser, said modulator modulating the light that is emitted from the coherent

light source and diffused by the diffuser; and

a projector lens for projecting an image that is obtained by light modulation by the spatial light modulator, on a certain plane in space;

wherein the spatial light modulator and the diffuser are separated from each other by a distance that is determined on the basis of a diffusion angle of the diffuser, a substantial numerical aperture of the illumination optical system, and a screen size of the spatial light modulator in a diagonal direction.

5. A two-dimensional image formation apparatus as defined in Claim 4 wherein

a relationship,

$$(\theta/2 + \sin^{-1}(NA_{in})) \times L < D/3$$

is established among the diffusion angle θ of the diffuser, the substantial numerical aperture NA_{in} of the illumination optical system, the distance L between the spatial light modulator and the diffuser, and the screen size D of the spatial light modulator in the diagonal direction.

6. An apparatus for forming a two-dimensional image by light modulation, comprising:

a coherent light source;

a diffuser for diffusing light;

an illumination optical system for irradiating the diffuser with light emitted from the coherent light source;

a spatial light modulator disposed near the diffuser, said modulator modulating the light that is emitted from the coherent light source and diffused by the diffuser; and

a projector lens for projecting an image of the spatial light modulator on a certain plane in space;

wherein the spatial light modulator and the diffuser are separated from each other by a distance that is determined on the basis of a pitch of unevenness in the transmissivity of the diffuser, and a substantial numerical aperture of the illumination optical system.

7. A two-dimensional image formation apparatus as defined in Claim 6 wherein

a relationship,

$$L \times \text{NA}_{\text{in}} > P$$

is established among the pitch P of unevenness in the transmissivity of the diffuser, the substantial numerical aperture NA_{in} of the illumination optical system, and the distance L between the spatial light modulator and the diffuser.

8. A two-dimensional image formation apparatus as defined in any of Claims 1 to 7 wherein

said illumination optical system includes a light integrator.

9. A two-dimensional image formation apparatus as defined in Claim 8 wherein

said light integrator comprises at least two lens arrays.

10. A two-dimensional image formation apparatus as defined in Claim 8 wherein

said light integrator comprises a rod type light integrator.

11. A two-dimensional image formation apparatus as defined in any of Claims 1 to 7 wherein

said diffuser comprises a pseudo random diffuser having a surface which is processed so as to obtain a desired diffusion angle.

12. A two-dimensional image formation apparatus as defined in Claim 11 wherein

said pseudo random diffuser is obtained by partitioning a surface of a transparent substrate in a lattice pattern to provide plural cell areas, and processing the cell areas so that adjacent cell areas have different heights.

13. A two-dimensional image formation apparatus as defined in Claim 12 wherein

in said pseudo random diffuser obtained by processing a

transparent substrate, a difference in heights between adjacent cell areas is set so that the phases of light beam passing through these cell areas are shifted by $\pi/4$ from each other.

14. A two-dimensional image formation apparatus as defined in Claim 11 wherein

said pseudo random diffuser has a concave-convex surface configuration in which the level of the surface thereof varies continuously.